Appendix A
Fisheries Enhancement within the Project Area, Past, On-going & Future Projects

John Day Subbasins
Past/On-Going Projects
BPA-Funded Projects **(Source: NPPC 2001)**

Organization	Type of Project	Date	Location	Summary
Reclamation/Water Users/BPA/GSWCD/ NRCS/ODFW/OWRD/ ODA/CTWSRO	Water Conservation Demonstration Project	1991-2000	Upper and Middle Fork John Day subbasins	Reclamation took lead for projects including 3 diversions, 2 pipeline systems, 5 irrigation reorganizations, 4 infiltration galleries, 2 ditch conversions, 2 return flow cooling, 1 aeration and subsoiling
Reclamation/ CTWSRO/GSWCD	Water conservation/flow improvement Passage improvement	ongoing	Entire John Day Basin	Return flow cooling: reroute irrigation return flow to underground to reduce temps and nutrients Replace flood irrigation and open systems with sprinkler and closed systems Pushup dams replaced with pumping systems, infiltration galleries and permanent diversions
ODFW	Fish screens	1995+	Entire John Day Basin, mainly mainstem	86 screens, mostly in mainstem John Day River 3 additional screens funded by OWEB O&M on 314 screens in John Day Basin via NMFS funding 228 existing sreens not meeting NMFS criteria will be funded via BPA and/or OWEB
North Fork Watershed Council	Passage improvement		Lower North Fork John Day	Replace gravel pushup dams with permanent pumping stations at River Meadows and Schultz Ranch
Oregon Wildlife Coalition	Flow improvement	ongoing	John Day Basin	Objective: permanent protection of priority wildlife habitats, through acquisition of in-stream water rights and other methods

BPA	Bonneville Power Administration
CTUIR	Confederated Tribes of the Umatilla Reservation
CTWSRO	Confederated Tribes of the Warm Springs Reservation of Oregon
FSA	Farm Service Agency
GSWCD	Grant Soil and Water Conservation District
NRCS	Natural Resources Conservation Service
ODA	Oregon Department of Agriculture
ODFW	Oregon Department of Fish & Wildlife
OWEB	Oregon Water Enhancement Board
OWRD	Oregon Water Resources Department
Reclamation	U.S. Bureau of Reclamation

John Day Subbasins

Past/On-Going Projects

Non-BPA Funded Projects **(Source: NPPC 2001)**

Organization	Type of Project	Date	Location	Summary
ODFW (funded by OWEB via grant to OWRD)	Streamflow restoration prioritization	1999	Entire John Day Basin	Prioritized streamflow restoration needs based on: physical/biological factors, water use patterns and restoration optimism; identified measures include: transfers and leases to in-stream uses, cancelled water rights, enforcement and monitoring, improved diversion methods, stream inventories, conservation planning, improved efficiencies, and measurement and reporting of use
North Fork Watershed Council	Streamflow restoration		Rudio Creek (Lower North Fork John Day)	Streamflow restoration
GSWCD (funded by Reclamation, private, FSA, OWRD, ODFW & OWEB)	Passage improvement	1992+	GSWCD	Irrigation reorganization, gravity pipeline, infiltration gallery, irrigation return flow cooling GSWCD acts as subcontractor for most of the ODFW, CTWSRO, and Reclamation projects
Reclamation (many with assistance of GSWCD)	Passage improvement Flow improvement	1991+	Upper & Middle Forks John Day	Replace pushup dams with infiltration galleries or pumps Convert from flood to sprinkler or wheel line irrigation, replace open ditches with pipelines Construct subsurface drainage system to return cooler water to the stream
Oregon Water Trust	Flow improvement	2000+	Middle Fork John Day Subbasin: Big Boulder Cr., Big Cr., Hawkins Cr., Middle Fork John Day and tributaries	Oregon Water Trust has negotiated donations of all or part of 18 water rights certificates to convert out-of-stream water rights for in-stream uses; conversions have provided 5 cfs flow in critical chinook and steelhead spawning and rearing habitat; right are held in trust by OWRD
Restoration and Enhancement Board (ODFW)	Passage improvement		South Fork John Day	Passage improvement at two irrigation diversion dams Funding provided by surcharge on angling licenses
John Day Bull Trout Recovery Team	Flow improvement		John Day Basin	Obtained in-stream water rights for bull trout on 24 streams or stream reaches, requested an additional 18 water rights which are being contested

John Day Subbasins

Future Projects

(Source: NPPC 2001)

Organization	Type of Project	Date	Location	Summary
Reclamation	Provide Technical Assistance	On-going	North Fork Middle Fork and Upper John Day subbasins	Provide technical support
ODFW	Fish screens		John Day Basin	Replace 20 out-of-date fish screens per year in the John Day Basin
North Fork Watershed Council	Passage Improvement	2002-06	Lower North Fork John Day	Replace gravel pushup dams with permanent pumping stations
CTWSRO	Passage improvement			Eliminate passage barriers Continuation and expansion of ongoing efforts
Oregon Water Trust	Flow improvement	2002-04	Entire John Day Basin	Proposes to acquire 2.0 cfs in John Day Basin over three years
CTWSRO	Passage improvement Fish screens Flow improvement	2002-06	Oxbow Ranch	Continued management
CTUIR	Passage improvement Flow improvement	2002-06	North Fork John Day	
OWEB	Passage barrier inventory		Entire John Day Basin	Inventory of all forms of barriers, utilizing existing databases; objective is prioritize approach to removing fish barriers
OWRD	Improved measurement and management of water flows		Entire John Day Basin	
ODFW	Develop GIS layers	2002-04	Entire John Day Basin	Obtain or develop GIS maps of fish passage barriers and points of irrigation diversion

Appendix B

John Day River Basin Water Conservation Demonstration Projects

Financial Contributions and Total Project Costs (Source: Reclamation 2000)

PARTNER	Reclamation[1]	GSWCD[2]	BPA	Water Users	NRCS &/or FSA	ODA	OWRD	ODFW	Total Project Cost
PROJECTS – Upper John Day subbasin unless noted otherwise.									
Luce-Long Diversion	$30,400	$4,100		$27,200	$5,000		$1,500	$1,200	$69,400
Holliday Ditch Diversion		$6,300	$17,400	$9,200	$4,000		$300	$600	$37,800
Keerins Diversion		$5,700	$22,000	$7,500	$200			$200	$35,600
Widows Creek Gravity Irrigation Pipeline Systems	$66,400	$9,100		$90,600	$35,400			$25,100	$226,600
Holmes Pipeline[3]		$2,700	$18,500	$3,700				$200	$25,100
Fields Infiltration Gallery	$72,000	$22,200	$64,900	$72,100	$5,200		$200	$300	$236,900
Lemon Infiltration Gallery	$22,000	$7,200		$9,100			$500	$500	$39,300
Courchesne Infiltration Gallery[3]		$4,400	$16,800	$8,900				$200	$30,300
Rudishauser Infiltration Gallery		$3,800		$9,400	$3,200		$500	$300	$17,200
Cathedral Rock Ditches Project	$21,600	$2,900		$86,400	$18,800		$20,000	$3,400	$153,100
Clausen Ditch Conversion	$43,100	$2,200		$70,500	$5,000			$600	$121,400
Kight Irrigation Reorganization	$49,600	$3,300		$43,800	$10,400		$700	$1,500	$109,300
Ediger Irrigation Reorganization	$47,300	$4,400		$36,500	$5,200		$2,400	$2,000	$97,800
Page Irrigation Reorganization	$65,300	$1,900		$62,500		$700			$130,400
Morris-Pike Irrigation Reorganization	$96,200	$7,400	$71,900	$117,800			$800	$1,000	$295,100
Lee Irrigation Reorganization		$9,800	$37,700	$19,700				$300	$67,500
Crown Ranch Return Flow Cooling[4]	$21,000	$8,300		$15,700	$1,200		$300	$200	$46,700
Holliday Ranches Return Flow Cooling[4]	$45,600	$6,100		$36,900	$2,500	$2,200	$500	$500	$94,300
Mullin Aeration and Subsoiling[4]	$3,400	$600		$3,400					$7,400
Total Project Costs	$583,900	$112,400	$249,200	$730,900	$96,100	$2,900	$27,700	$38,100	$1,841,200

[1] Reclamation provided $270,000 to the Tribes for project development, coordination, and monitoring
[2] Reclamation funding was provided to GSWCD to assist with project development and implementation
[3] Middle Fork John Day subbasin
[4] These projects are outside the scope of this PEA

Appendix C
NMFS' Juvenile Fish Screen Criteria For Pump Intakes

Developed by
National Marine Fisheries Service
Environmental & Technical Services Division
Portland, Oregon
May 9, 1996

The following criteria serve as an addendum to current National Marine Fisheries Service gravity intake juvenile fish screen criteria. These criteria apply to new pump intake screens and existing inadequate pump intake screens, as determined by fisheries agencies with project jurisdiction.

<u>Definitions used in pump intake screen criteria</u>
Pump intake screens are defined as screening devices attached directly to a pressurized diversion intake pipe. Effective screen area is calculated by subtracting screen area occluded by structural members from the total screen area. Screen mesh opening is the narrowest opening in screen mesh. Approach velocity is the calculated velocity component perpendicular to the screen face. Sweeping velocity is the flow velocity component parallel to the screen face with the pump turned off.

Active pump intake screens are equipped with a cleaning system with proven cleaning capability, and are cleaned as frequently as necessary to keep the screens clean. Passive pump intake screens have no cleaning system and should only be used when the debris load is expected to be low, and

1) if a small screen (less than 1 cfs pump) is over-sized to eliminate debris impingement, and
2) where sufficient sweeping velocity exists to eliminate debris build-up on the screen surface, and
3) if the maximum diverted flow is less than .01% of the total minimum streamflow, or
4) the intake is deep in a reservoir, away from the shoreline.

<u>Pump Intake Screen Flow Criteria</u>
The minimum effective screen area in square feet for an active pump intake screen is calculated by dividing the maximum flow rate in cubic feet per second (cfs) by an approach velocity of 0.4 feet per second (fps). The minimum effective screen area in square feet for a passive pump intake screen is calculated by dividing the maximum flow rate in cfs by an approach velocity of 0.2 fps. Certain site conditions may allow for a waiver of the 0.2 fps approach velocity criteria and allow a passive screen to be installed using 0.4 fps as design criteria. These cases will be considered on a site-by-site basis by the fisheries agencies.

If fry-sized salmonids (i.e. less than 60 millimeter fork length) are not ever present at the site and larger juvenile salmonids are present (as determined by agency biologists), approach velocity shall not exceed 0.8 fps for active pump intake screens, or 0.4 fps for passive pump intake screens. The allowable flow should be distributed to achieve uniform approach velocity (plus or minus 10%) over the entire screen area. Additional screen area or flow baffling may be required to account for designs with non-uniform approach velocity.

Pump Intake Screen Mesh Material

Screen mesh openings shall not exceed 3/32 inch (2.38 mm) for woven wire or perforated plate screens, or 0.0689 inch (1.75 mm) for profile wire screens, with a minimum 27% open area. If fry-sized salmonids are never present at the site (by determination of agency biologists) screen mesh openings shall not exceed 1/4 inch (6.35 mm) for woven wire, perforated plate screens, or profile wire screens, with a minimum of 40% open area.

Screen mesh material and support structure shall work in tandem to be sufficiently durable to withstand the rigors of the installation site. No gaps greater than 3/32 inch shall exist in any type screen mesh or at points of mesh attachment. Special mesh materials that inhibit aquatic growth may be required at some sites.

Pump Intake Screen Location

When possible, pump intake screens shall be placed in locations with sufficient sweeping velocity to sweep away debris removed from the screen face. Pump intake screens shall be submerged to a depth of at least one screen radius below the minimum water surface, with a minimum of one screen radius clearance between screen surfaces and adjacent natural or constructed features. A clear escape route should exist for fish that approach the intake volitionally or otherwise. For example, if a pump intake is located off of the river (such as in an intake lagoon), a conventional open channel screen should be considered, placed in the channel or at the edge of the river. Intakes in reservoirs should be as deep as practical, to reduce the numbers of juvenile salmonids that approach the intake. Adverse alterations to riverine habitat shall be minimized.

Pump Intake Screen Protection

Pump intake screens shall be protected from heavy debris, icing and other conditions that may compromise screen integrity. Protection can be provided by using log booms, trash racks or mechanisms for removing the intake from the river during adverse conditions. An inspection and maintenance plan for the pump intake screen is required, to ensure that the screen is operating as designed per these criteria.

Appendix D
NMFS' Juvenile Fish Screen Criteria

Developed by
National Marine Fisheries Service
Environmental & Technical Services Division
Portland, Oregon
Revised February 16, 1995

I. GENERAL CONSIDERATIONS:

This document provides guidelines and criteria to be utilized in the development of functional designs of downstream migrant fish passage facilities for hydroelectric, irrigation, and other water withdrawal projects. This material has been prepared by the National Marine Fisheries Service (NMFS) as a direct result of responsibilities for prescribing fishways (including fish screen and bypass systems) under Section 18 of the Federal Power Act, administered by the Federal Energy Regulatory Commission (FERC). This material is also applicable for projects that are undergoing consultation with the NMFS, pursuant to responsibilities for protecting fish under the Endangered Species Act (ESA).

Since these guidelines and criteria are general in nature, there may be cases where site constraints or extenuating circumstances dictate that certain criteria be waived or modified. Conversely, where there is a need to provide additional protection for fish, site-specific criteria may be added. These circumstances will be considered by NMFS on a project-by-project basis.

In designing an effective fish screen facility, the swimming ability of the fish is a primary consideration. Research has shown that swimming ability of fish varies and may depend upon a number of factors relating to the physiology of the fish, including species, size, duration of swimming time required, behavioral aspects, migrational stage, physical condition and others, in addition to water quality parameters such as dissolved oxygen concentrations, water temperature, lighting conditions, and others. For this reason, screen criteria must be expressed in general terms.

To minimize risks to anadromous fish at some locations, the NMFS may require investigation (by the project sponsors) of important and poorly defined site-specific variables that are deemed critical to development of the screen and bypass design. This investigation may include factors such as fish behavioral response to hydraulic conditions, weather conditions (ice, wind, flooding, etc.), river stage-discharge relationships, seasonal operational variability, potential for sediment and debris problems, resident fish populations, potential for creating predation opportunity, and other information. The size of salmonids present at a potential screen site usually is not known, and can change from year to year based on flow and temperature conditions. Thus, adequate data to describe the size-time relationship requires substantial sampling efforts over a number of years. The NMFS will assume that fry-sized salmonids and low water temperatures are present at all sites and apply the appropriate criteria listed below, unless adequate biological investigation proves otherwise. The burden-of-proof is the responsibility of the owner of the screen facility.

Proposed facilities which could have particularly significant impacts on fish, and new unproven juvenile fish protection designs, frequently require: 1) development of a biological basis for the concept; 2) demonstration of favorable fish behavioral response in a laboratory setting; 3) an acceptable plan for evaluating the prototype installation; and 4) an acceptable alternate plan developed concurrently for a screen and bypass system satisfying these criteria, should the prototype not adequately protect fish. Additional information on unproven juvenile fish protection devices can be found in "Experimental Fish Guidance Devices," Position Statement of the National Marine Fisheries Service, Northwest Region, January 6, 1995.

Screen and bypass criteria for juvenile salmonids are provided below. Specific exceptions to these criteria occur in the design of small screen and bypass systems (less than 25 cubic feet per second). These are listed in Section K, Modified Criteria for Small Screens.

Striped bass, herring, shad, and other anadromous fish species may have eggs and/or very small fry which are moved with any water current (tides, streamflows, etc.). Installations where these species are present may require special screen and/or bypass facilities, including micro-screens and require individual evaluation of the proposed project. In instances where local regulatory agencies require more stringent screening requirements for species of resident or anadromous fish, the NMFS will generally defer to the more conservative criteria.

II. GENERAL PROCEDURAL GUIDELINES

A functional design should be developed that defines type, location, size, hydraulic capacity, method of operation, and other pertinent juvenile fish screen facility characteristics. In the case of applications to be submitted to the FERC and consultations under the ESA, a functional design for juvenile (and adult) fish passage facilities must be developed and submitted as part of the application. It must reflect the NMFS input and design criteria and be acceptable to the NMFS. Functional design drawings must show all pertinent hydraulic information, including water surface elevations and flows through various areas of the structures. Functional design drawings must show general structural sizes, cross-sectional shapes, and elevations. Types of materials must be identified where they will directly affect fish. The final detailed design shall be based on the functional design, unless changes are agreed to by the NMFS.

All juvenile passage facilities shall be designed to function properly through the full range of hydraulic conditions in the lake, tidal area, or stream and in the diversion, and shall account for debris and sedimentation conditions which may occur.

III. SCREEN CRITERIA FOR JUVENILE SALMONIDS

A. Structure Placement

1. Streams and Rivers:

a. Where physically practical and biologically desirable, the screen shall be constructed at the diversion entrance with the screen face generally parallel to river flow. Physical factors that may preclude screen construction at the diversion entrance include excess river gradient, potential for damage by large debris, and potential for heavy sedimentation. For screens constructed at the bankline, the screen face shall be aligned with the adjacent bankline and the bankline shall be shaped to smoothly match the face of the screen structure to prevent eddies in front, upstream, and downstream of the screen. If trash racks are used, sufficient hydraulic gradient is required to route juvenile fish from between the trash rack and screens to safety.

b. Where installation of fish screens at the diversion entrance is not desirable or impractical, the screens may be installed in the canal downstream of the entrance at a suitable location. All screens installed downstream from the diversion entrance shall be provided with an effective bypass system approved by NMFS, designed to collect juvenile fish and safely transport them back to the river with minimum delay. The angle of the screen to flow should be adequate to effectively guide fish to the bypass (see Section F, Bypass Layout).

2. Lakes, Reservoirs and Tidal areas:

a. Intakes shall be located offshore where feasible to minimize fish contact with the facility. Water velocity from any direction toward the screen shall not exceed allowable approach velocities (see Section B, Approach Velocity). When possible, intakes shall be located in areas with sufficient sweeping velocity to minimize sediment accumulation in or around the screen and to facilitate debris removal and fish movement away from the screen face (see Section C, Sweeping Velocity).

b. If a screened intake is used to route fish past a dam, the intake shall be designed to withdraw water from the most appropriate elevation based on providing the best juvenile fish attraction and appropriate water temperature control downstream of the project. The entire range of forebay fluctuation shall be accommodated in design, unless otherwise approved by the NMFS.

B. Approach Velocity - Definition: Approach velocity is the water velocity component perpendicular to and approximately three inches in front of the screen face.

1. Salmonid fry [less than 2.36 inches {60.0 millimeters (mm)} in length]: The approach velocity shall not exceed 0.40 feet per second (fps) {0.12 meters per second (mps)}.

2. Salmonid fingerling {2.36 inches (60.0 mm) and longer}: The approach velocity shall not exceed 0.80 fps (0.24 mps).

3. The total submerged screen area required (excluding area affected by structural components) is calculated by dividing the maximum diverted flow by the allowable approach velocity (also see Section K, Modified Criteria for Small Screens).

4. The screen design must provide for uniform flow distribution over the screen surface, thereby minimizing approach velocity. This may be accomplished by providing adjustable porosity control on the downstream side of screens, unless it can be shown unequivocally (such as with a physical hydraulic model study) that localized areas of high velocity can be avoided at all flows.

C. Sweeping Velocity - Definition: Sweeping velocity is the water velocity component parallel and adjacent to the screen face.

1. Sweeping velocity shall be greater than the approach velocity. This is accomplished by angling the screen face at less than 45° relative to flow (also see Section K, Modified Criteria for Small Screens). This angle may be dictated by site specific canal geometry, hydraulic, and sediment conditions.

D. Screen Face Material

1. Fry criteria - If biological justification can not be provided to demonstrate the absence of fry-sized salmonids {less than 2.36 inches (60.0 mm)} in the vicinity of the diversion intake leading to the screen, fry will be assumed present and the following criteria apply for screen material:

a. Perforated plate: Screen openings shall not exceed 3/32 or 0.0938 inches (2.38 mm).

b. Profile bar screen: The narrowest dimension in the screen openings shall not exceed 0.0689 inches (1.75 mm) in the narrow direction.

c. Woven wire screen: Screen openings shall not exceed 3/32 or 0.0938 inches (2.38 mm) in the narrow direction (example: 6-14 mesh).

d. Screen material shall provide a minimum of 27% open area.

2. Fingerling criteria - If biological justification can be provided to demonstrate the absence of fry-sized salmonids {less than 2.36 inches (60.0 mm)} in the vicinity of the diversion intake leading to the screen, the following criteria apply for screen material:

a. Perforated plate: Screen openings shall not exceed 1/4 or 0.25 inches (6.35 mm).

b. Profile bar screen: The narrowest dimension in the screen openings shall not exceed 1/4 or 0.25 inches (6.35 mm) in the narrow direction.

c. Woven wire screen: Screen openings shall not exceed 1/4 or 0.25 inches (6.35 mm) in the narrow direction.

d. Screen material shall provide a minimum of 40% open area.

3. The screen material shall be corrosion resistant and sufficiently durable to maintain a smooth uniform surface with long term use.

E. Civil Works and Structural Features

1. The face of all screen surfaces shall be placed flush (to the extent possible) with any adjacent screen bay, pier noses, and walls to allow fish unimpeded movement parallel to the screen face and ready access to bypass routes.

2. Structural features shall be provided to protect the integrity of the fish screens from large debris. Provision of a trash rack, log boom, sediment sluice, and other measures may be needed. A reliable, ongoing preventative maintenance and repair program is necessary to assure facilities are kept free of debris and that screen mesh, seals, drive units, and other components are functioning correctly.

3. Screen surfaces shall be constructed at an angle to the approaching flow, with the downstream end of the screen terminating at the entrance to the bypass system.

4. The civil works shall be designed in a manner that eliminates undesirable hydraulic effects (such as eddies and stagnant flow zones) that may delay or injure fish or provide predator habitat or predator access. Upstream training wall(s), or some acceptable variation thereof, shall be utilized to control hydraulic conditions and define the angle of flow to the screen face. Large facilities may require hydraulic modeling to identify and correct areas of concern.

F. Bypass Layout

1. The screen and bypass shall work in tandem to move out-migrating salmonids (including adults) to the bypass outfall with a minimum of injury or delay. The bypass entrance shall be located so that it can easily be located by out-migrants. Screens placed in diversions shall be constructed with the downstream end of the screen terminating at a bypass entrance. Multiple bypass entrances (intermediate bypasses) shall be employed if the sweeping velocity will not move fish to the bypass within 60 seconds, assuming fish are transported at this velocity.

2. The bypass entrance and all components of the bypass system shall be of sufficient size and hydraulic capacity to minimize the potential for debris blockage.

3. In order to improve bypass collection efficiency for a single bank of vertically-oriented screens, a bypass training wall shall be located at an angle to the screens, with the bypass entrance at the apex and downstream-most point. This will aid fish movement into the bypass by creating hydraulic conditions that conform to observed fish behavior. For single or multiple vee screen configurations, training walls are not required, unless a intermediate bypass is used (see Section F, Bypass Layout, Part 1).

4. In cases where there is insufficient flow available to satisfy hydraulic requirements at the bypass entrance (entrances) for the main screens, a secondary screen may be required. This is a screen located in the main screen bypass which allows the prescribed bypass flow to be used to effectively attract fish into the bypass entrance(s) and then allow for all but a reduced residual bypass flow to be routed back (by pump or gravity) for the primary diversion use. The residual bypass flow (not passing through the secondary screen) would then convey fish to the bypass outfall location or other destination.

5. Access is required at locations in the bypass system where debris accumulations may occur.

6. The screen civil works floor shall be designed to allow fish to be routed back to the river safely, if the canal is dewatered. This may entail a sumped drain with a small gate and drain pipe, or similar provisions.

G. Bypass Entrance

1. Each bypass entrance shall be provided with independent flow-control capability, acceptable to NMFS.

2. The minimum bypass entrance flow velocity must be greater than or equal to the maximum flow velocity vector resultant upstream of the screens. A gradual and efficient acceleration of flow into the bypass entrance is required to minimize delay by out-migrants.

3. Ambient lighting conditions are required at, and inside of, the bypass entrance and should extend downstream to the bypass flow control.

4. The bypass entrance must extend from the floor to the canal water surface.

H. Bypass Conduit Design

1. Bypass pipes shall have smooth surfaces and be designed to provide conditions that minimize turbulence. Bypass conduits shall have a smooth joint design to minimize turbulence and the potential for fish injury and shall be satisfactory to the NMFS.

2. Fish shall not be pumped within the bypass system.

3. Fish shall not be allowed to free-fall within a confined shaft in a bypass system.

4. Pressures in the bypass pipe shall be equal to or above atmospheric pressures.

5. Bends shall be avoided in the layout of bypass pipes due to the potential for debris clogging. Bypass pipe center-line radius of curvature (R/D) shall be greater than or equal to 5. Greater R/D may be required for super-critical velocities.

6. Bypass pipes or open channels shall be designed to minimize debris clogging and sediment deposition and to facilitate cleaning as necessary. Therefore, the required pipe diameter shall be greater than or equal to 24 inches {0.610 meters (m)}, and pipe velocity shall be greater than 2.0 fps (0.610 mps), unless otherwise approved by the NMFS, for the entire operational range (also see Section K, Modified Criteria for Small Screens, Part 4).

7. Closure valves of any type are not allowed within the bypass pipe, unless approved by NMFS.

8. The minimum depth of open-channel flow in a bypass conduit shall be greater than or equal to 0.75 feet (0.23 m), unless otherwise approved by the NMFS (also see Section K, Modified Criteria for Small Screens, Part 5).

9. Sampling facilities installed in the bypass conduit shall not impair normal operation of the facility.

10. The bypass pipe hydraulics should not produce a hydraulic jump within the pipe.

I. Bypass Outfall

1. Bypass outfalls should be located such that ambient river velocities are greater than 4.0 fps (1.2 mps).

2. Bypass outfalls shall be located to minimize avian and aquatic predation in areas free of eddies, reverse flow, or known predator habitat.

3. Bypass outfalls shall be located where the receiving water is of sufficient depth (depending on the impact velocity and quantity of bypass flow) to ensure that fish injuries are avoided at all river and bypass flows.

4. Maximum bypass outfall impact velocity (including vertical and horizontal velocity components) shall be less than 25.0 fps (7.6 mps).

5. The bypass outfall discharge into tailrace shall be designed to avoid adult attraction or jumping injuries.

J. Operations and Maintenance

1. Fish screens shall be automatically cleaned as frequently as necessary to prevent accumulation of debris. The cleaning system and protocol must be effective, reliable, and satisfactory to the NMFS. Proven cleaning technologies are preferred.

2. Open channel intakes shall include a trash rack in the screen facility design which shall be kept free of debris. In certain cases, a satisfactory profile bar screen design can substitute for a trash rack.

3. The head differential to trigger screen cleaning for intermittent type cleaning systems shall be a maximum of 0.1 feet (0.03 m) or as agreed to by the NMFS.

4. The completed screen and bypass facility shall be made available for inspection by NMFS, to verify compliance with the design and operational criteria.

5. Screen and bypass facilities shall be evaluated for biological effectiveness and to verify that hydraulic design objectives are achieved.

K. Modified Criteria for Small Screens (Diversion flow less than 25 cfs)

The following criteria vary from the criteria listed above and apply to smaller screens. Twenty-five cfs is an approximate cutoff; however, some smaller diversions may be required to apply more universal criteria listed above, while some larger diversions may be allowed to use the "small screen" criteria listed below. This will depend on site constraints.

1. The screen area required is shown in Section B, Approach Velocity, Parts 1, 2 and 3. Note that "maximum" applies to the greatest flow diverted, not necessarily the water right.

2. Screen orientation:

a. For screen lengths less than or equal to 4 feet, screen orientation may be angled or perpendicular relative to flow.

b. For screen lengths greater than 4 feet, screen-to-flow angles must be less than or equal to 45 degrees (see Section C, Sweeping Velocity, Part 1).

c. For drum screens, the design submergence shall be 75% of drum diameter. Submergence shall not exceed 85%, nor be less than 65% of drum diameter.

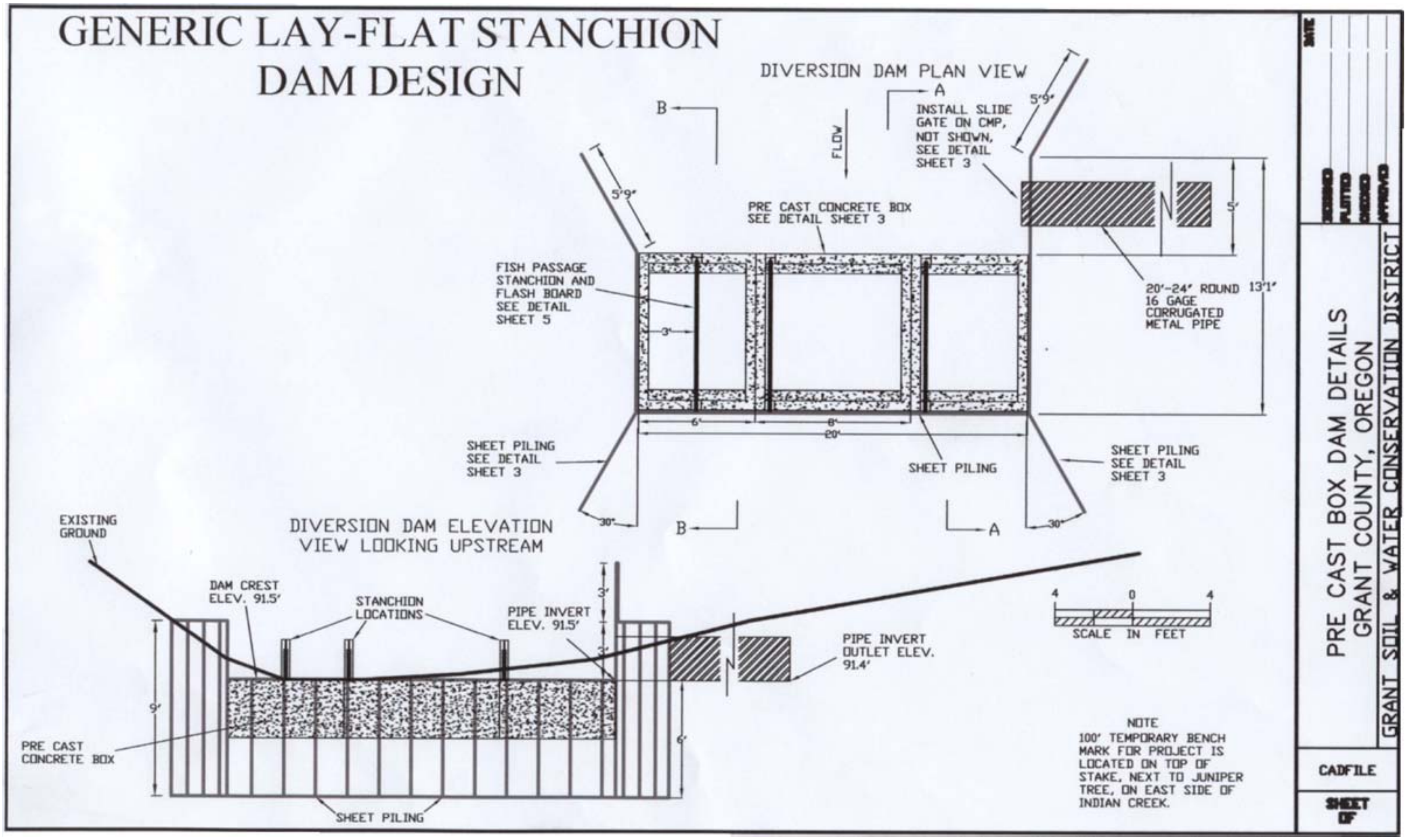
3. The minimum bypass pipe diameter shall be 10 inches, unless otherwise approved by NMFS.

4. The minimum allowable pipe depth is 0.15 feet (1.8 inches or 4.6 cm) and is controlled by designing the pipe gradient for minimum bypass flow.

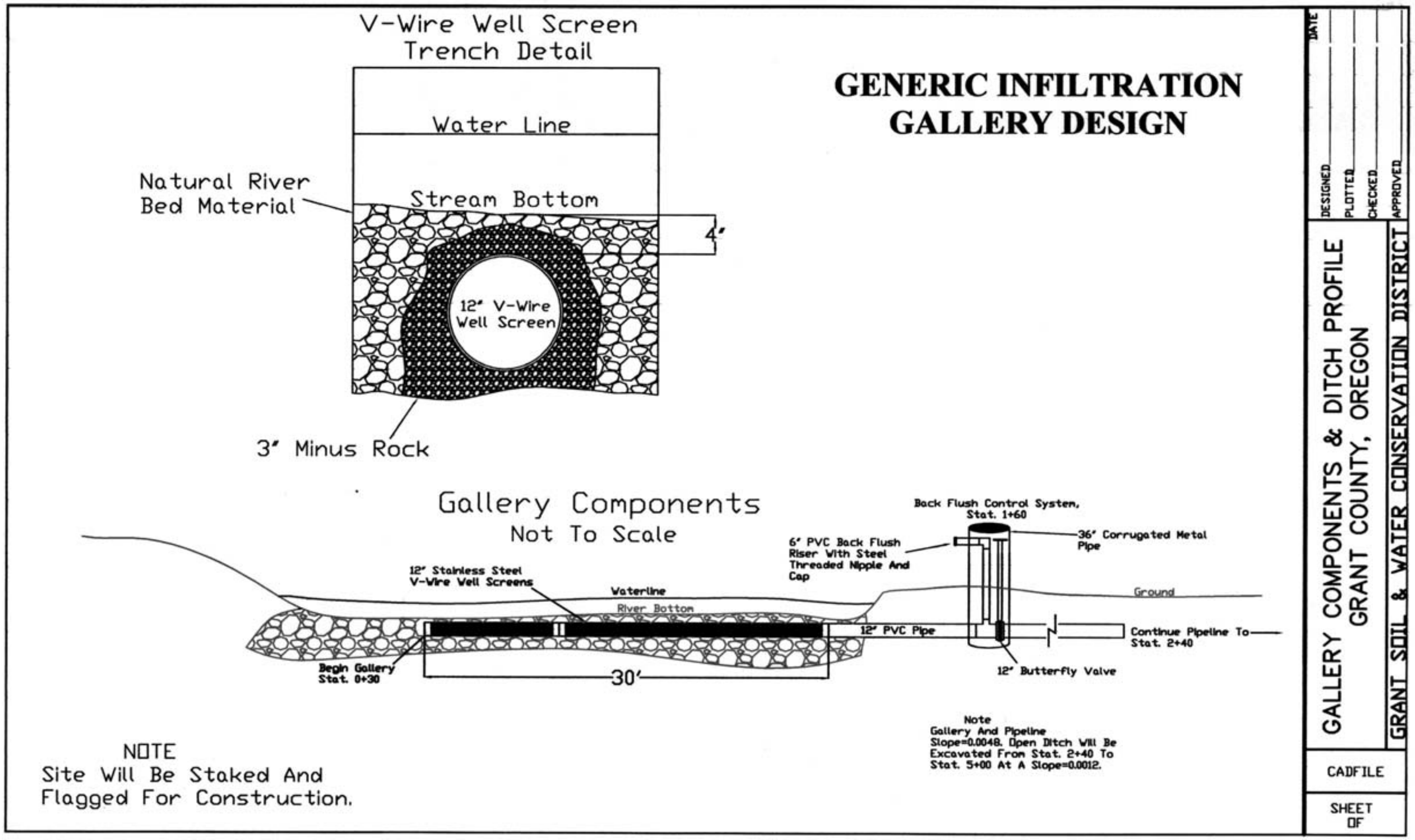
Questions concerning this document can be directed to NMFS Environmental and Technical Services Division Engineering staff, at 503-230-5400.

Adopted,
William Stelle, Jr. Date
Regional Director

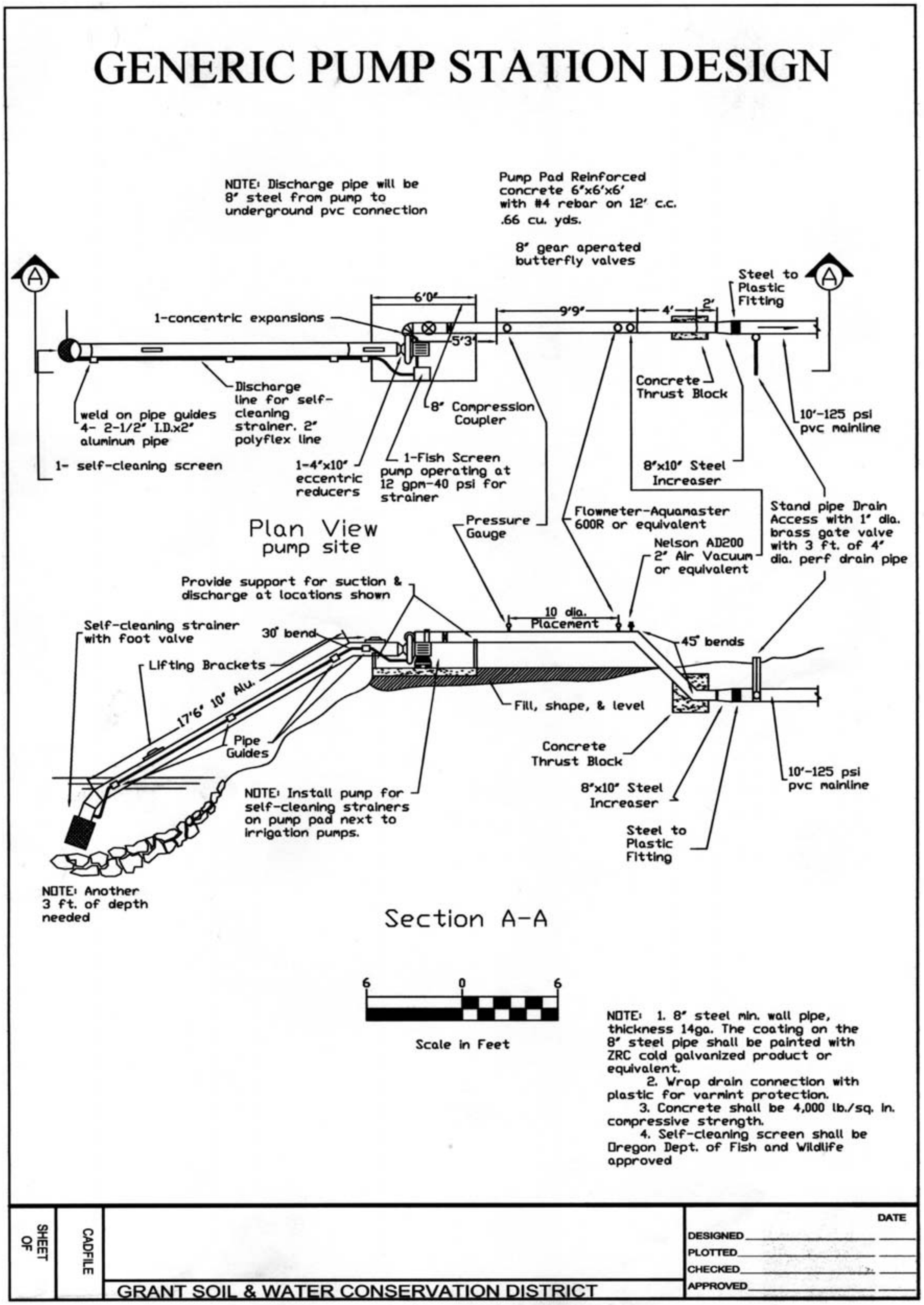
Appendix E
Generic LFSD Design



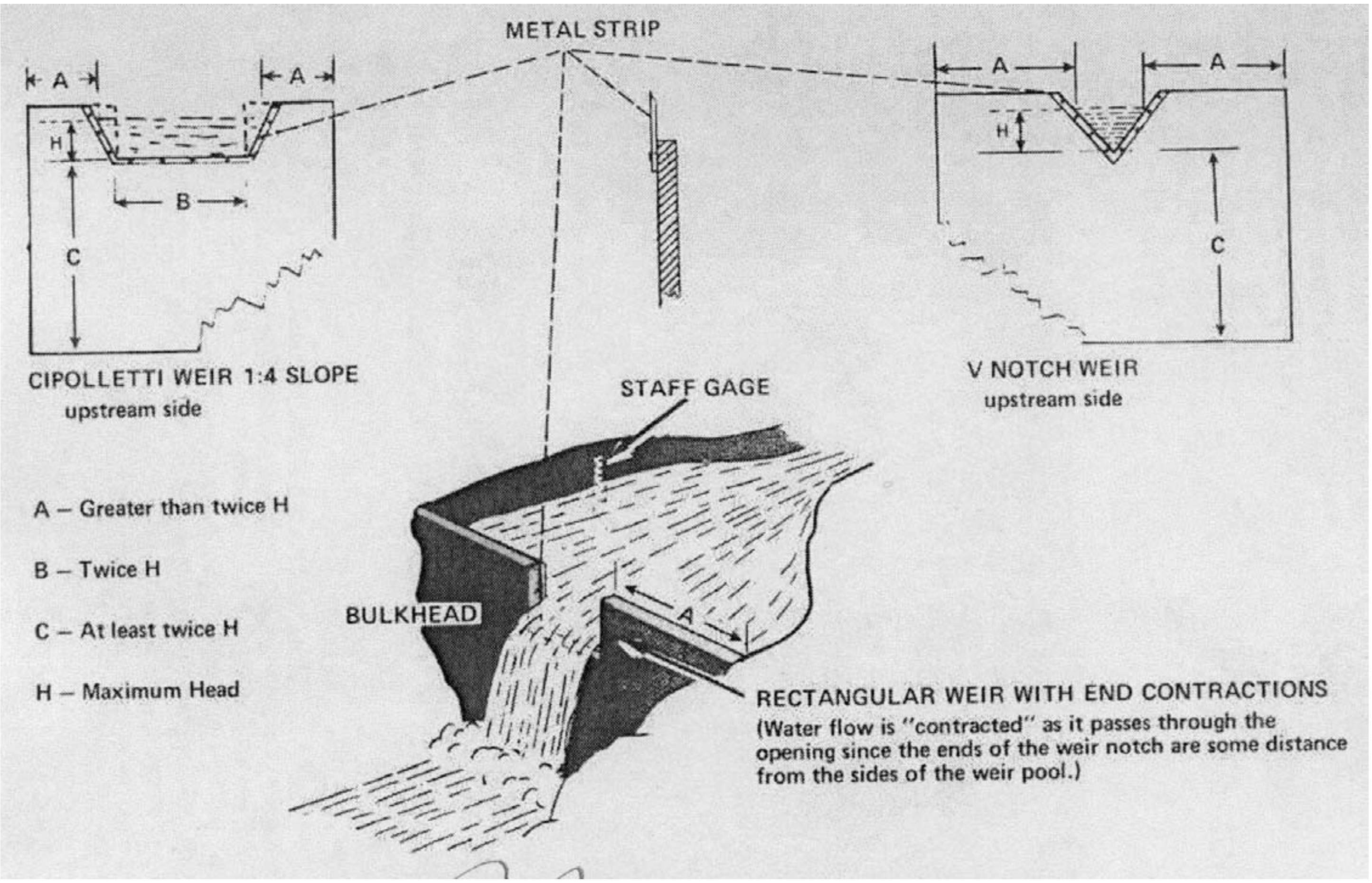
Appendix F
Generic Infiltration Gallery Design



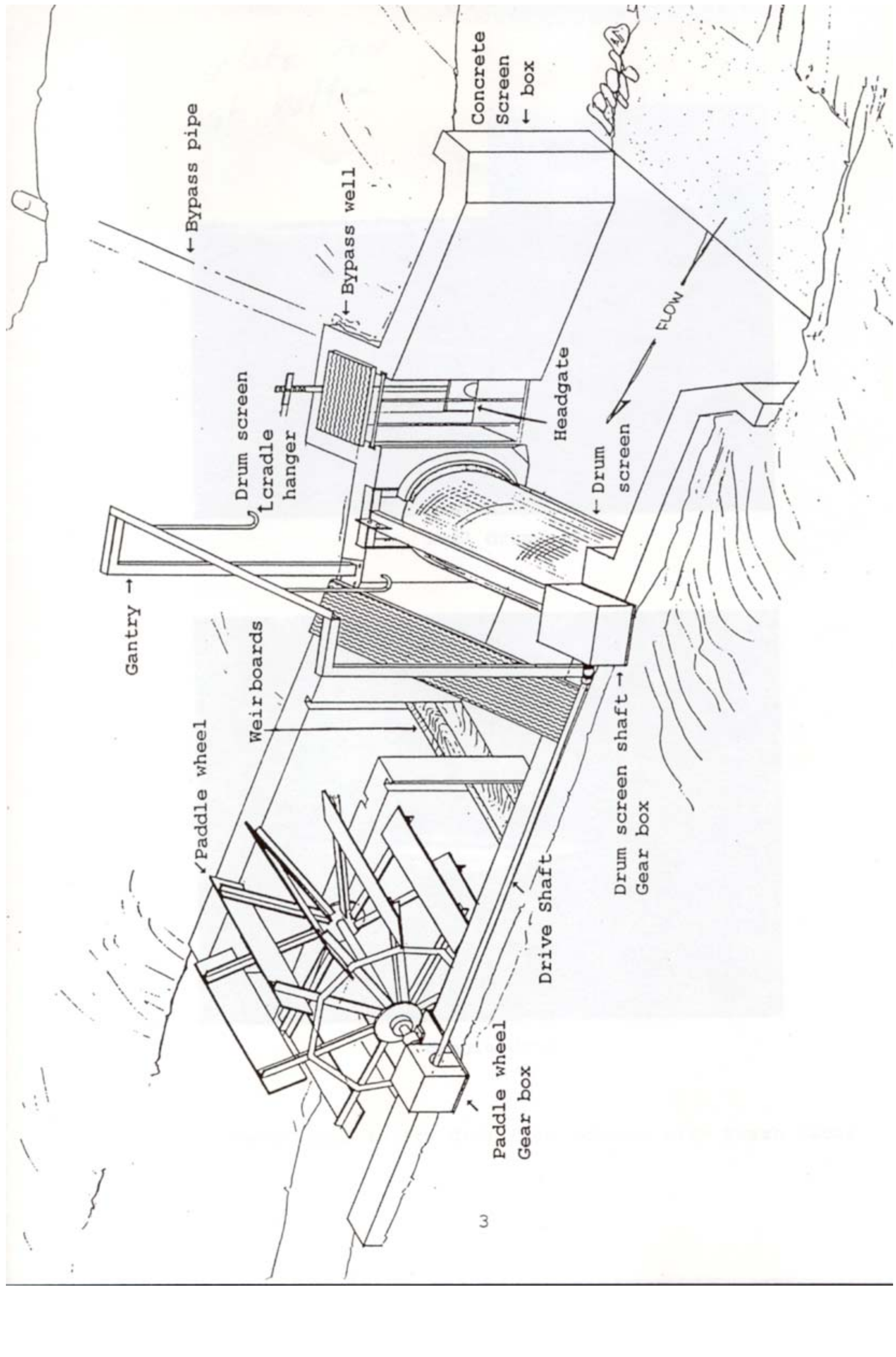
Appendix G


GENERIC PUMP STATION DESIGN
NOTE: Discharge pipe will be 8" steel from pump to underground pvc connection
Pump Pad Reinforced concrete 6'x6'x6' with #4 rebar on 12' c.c. .66 cu. yds.
8" gear aperated butterfly valves
Steel to Plastic Fitting
6'0"
9'9"
4'
2'
5'3"
1-concentric expansions
Discharge line for self-cleaning strainer. 2" polyflex line
weld on pipe guides 4- 2-1/2" I.D.x2" aluminum pipe
1- self-cleaning screen
8" Compression Coupler
1-4"x10" eccentric reducers
1-Fish Screen pump operating at 12 gpm-40 psi for strainer
Concrete Thrust Block
10'-125 psi pvc mainline
8"x10" Steel Increaser
Stand pipe Drain Access with 1" dia. brass gate valve with 3 ft. of 4" dia. perf drain pipe
Plan View
pump site
Pressure Gauge
Flowmeter-Aquamaster 600R or equivalent
Nelson AD200 2" Air Vacuum or equivalent
Provide support for suction & discharge at locations shown
Self-cleaning strainer with foot valve
30° bend
10 dia. Placement
45° bends
Lifting Brackets
17'6" 10" Alu.
Fill, shape, & level
Pipe Guides
Concrete Thrust Block
10'-125 psi pvc mainline
8"x10" Steel Increaser
NOTE: Install pump for self-cleaning strainers on pump pad next to irrigation pumps.
Steel to Plastic Fitting
NOTE: Another 3 ft. of depth needed
Section A-A
6
0
6
Scale in Feet
NOTE: 1. 8" steel min. wall pipe, thickness 14ga. The coating on the 8" steel pipe shall be painted with ZRC cold galvanized product or equivalent.
2. Wrap drain connection with plastic for varmint protection.
3. Concrete shall be 4,000 lb./sq. in. compressive strength.
4. Self-cleaning screen shall be Oregon Dept. of Fish and Wildlife approved
SHEET OF
CADFILE
GRANT SOIL & WATER CONSERVATION DISTRICT
DATE
DESIGNED
PLOTTED
CHECKED
APPROVED

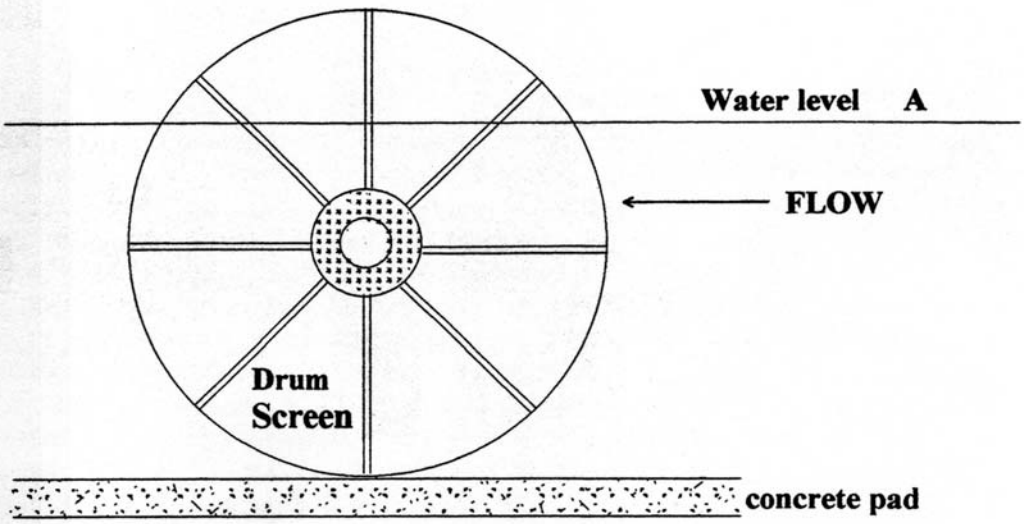
Appendix H
Sharp-crested Weirs



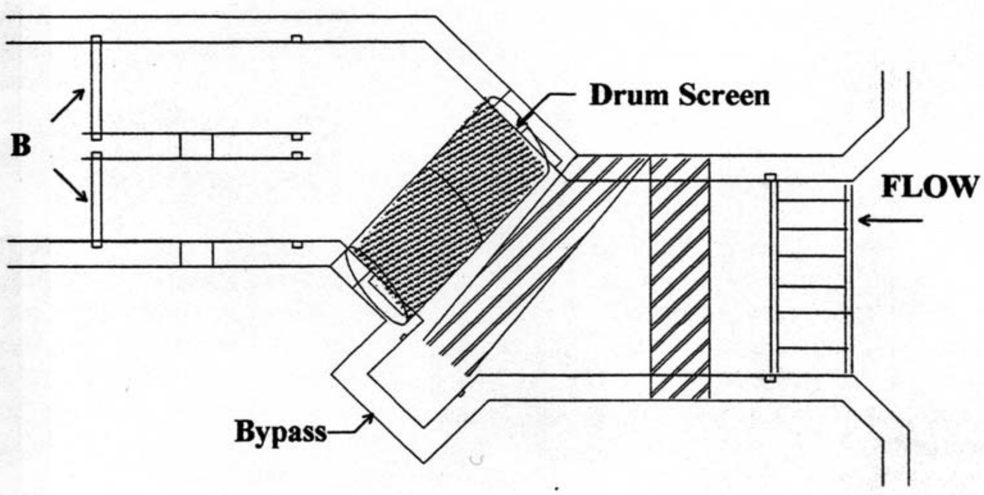
Appendix I
Rotary Fish Screen Design



Appendix J
Rotary Fish Screen Design

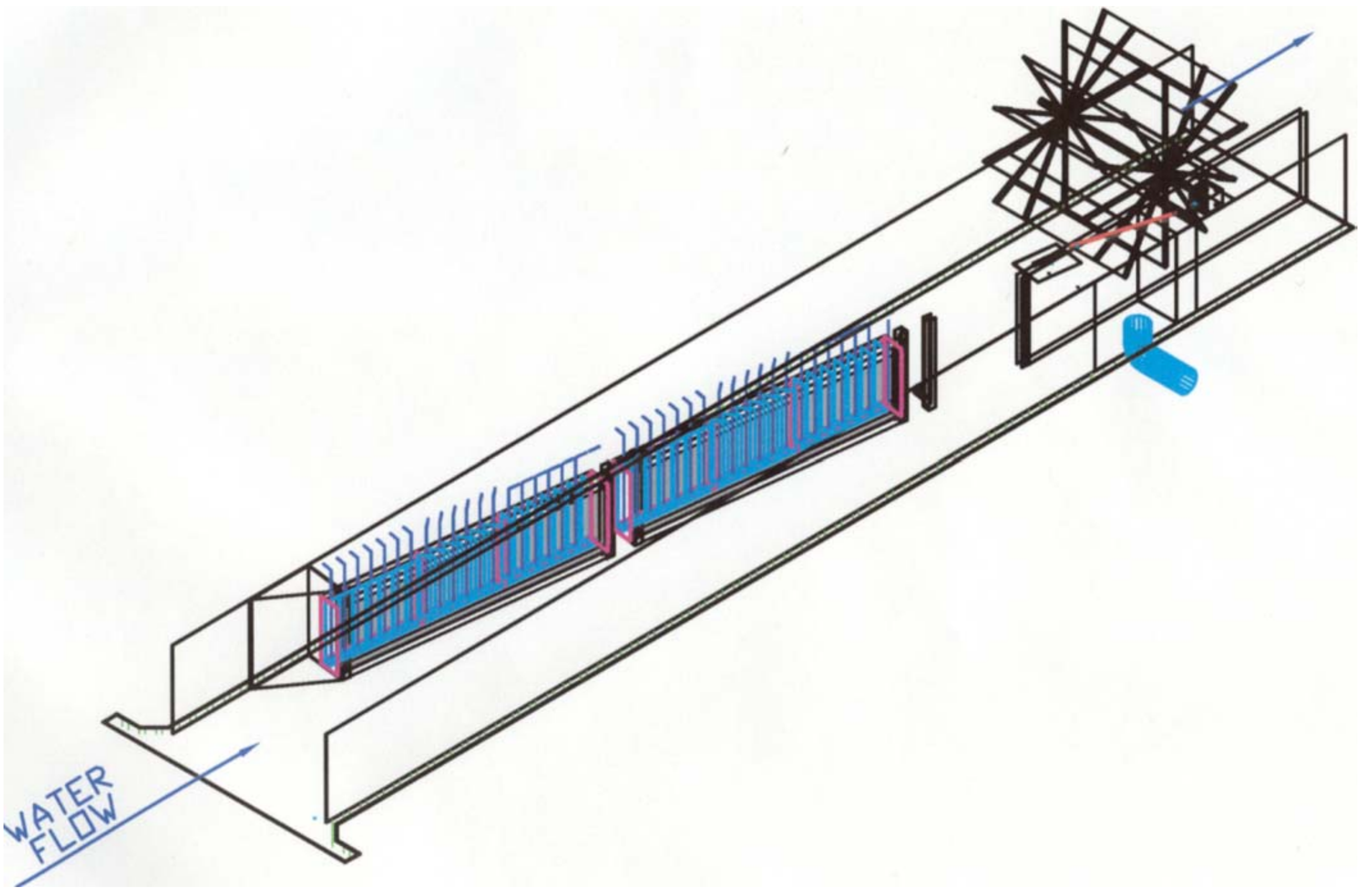


A: Maintain water level at 75% submergence



B: Weir boards adjust submergence

Appendix K
Flat Plate Fish Screen Design



Appendix L
Flat Plate Fish Screen Design